Skills Research Initiative
Initiative de recherche sur les compétences

Labour Market Implications of an Aging Population

Daniel Boothby (Industry Canada),
Julie Dubois (Human Resources Development Canada),
Maxime Fougère (Human Resources Development Canada),
Bruno Rainville (Human Resources Development Canada)

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B. Employer-Supported Training;
C. Adjustments in Markets for Skilled Workers;
D. International Mobility of Skilled Workers.

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B. la formation en entreprise;
C. l'adaptation du marché du travail aux travailleurs spécialisés;
D. la mobilité des travailleurs spécialisés dans le monde.

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Abstract

The Canadian population, like those of the other advanced economies, is aging rapidly. One important aspect of population aging is the aging of the Canadian working-age population and workforce. The research theme developed in this issues paper is the effects of population aging on the Canadian labour market.

Three areas for policy research directly linked to aging and the work force are discussed. The first is the determinants of the labour force participation decisions of older workers. The policy questions underlying this research issue are to identify barriers to labour force participation by older workers and to examine the welfare consequences of offsetting the effects of demographic changes by maintaining or prolonging the employment of older workers.

The second area for policy research is the relation between an aging population and the use of skills in the economy. In particular, this research area concerns: the effects of aging on the level and types of skills supplied by the workforce; and the effects of age differences in skills in the context of an aging population on the demand for labour by employers and on employers' introduction of new technologies and of new forms of workplace organization.

The third area for research concerns the costs of adjusting to population and workforce aging. At the level of the economy, the changes resulting from population aging will occur gradually over a period of twenty or more years. Nonetheless, an increased level of retirements and the changing age composition of the workforce may result in increased costs of workforce adjustments. Furthermore, while changes resulting from workforce aging will occur gradually for the economy as a whole, this may not be true of certain firms, industries or occupations, with implications for adjustment costs.

For each of these research areas, relevant economic research is discussed and a series of research issues is presented.

Résumé

La population du Canada, à l'instar de celle des autres économies avancées, vieillit rapidement. L'un des aspects importants du vieillissement de la population est le vieillissement de la population en âge de travailler et de la main-d'oeuvre au Canada. Le thème étudié dans ce document a trait aux effets du vieillissement de la population sur le marché du travail au Canada.

On y parle de trois domaines de recherches sur les politiques directement liés au vieillissement et à la main-d'oeuvre. Le premier porte sur les facteurs qui incitent les travailleurs âgés à rester sur le marché du travail. Les auteurs ont voulu cerner les obstacles à la participation des travailleurs âgés au marché du travail et examiner les

conséquences pour le bien-être de compenser les effets de l'évolution démographique en maintenant ou en prolongeant la période d'activité des travailleurs âgés.

Le deuxième porte sur le lien entre le vieillissement de la population et l'utilisation de la main-d'oeuvre spécialisée dans l'économie. En particulier, l'étude de ce thème gravite autour des préoccupations suivantes : les effets du vieillissement sur le niveau et le type de compétences offertes par la main-d'oeuvre; les effets de la composition de la main-d'œuvre spécialisée selon l'âge dans un contexte de vieillissement de la population sur la demande de main-d'oeuvre des employeurs et sur l'introduction, par les employeurs, de nouvelles technologies et de nouvelles formes d'organisation du milieu du travail.

Le troisième porte sur les coûts de l'adaptation au vieillissement de la population et de la main-d'oeuvre. À l'échelle de l'économie, les changements découlant du vieillissement de la population se produiront progressivement sur une période de 20 ans ou plus. Par contre, il se peut que cela ne soit pas le cas pour certaines entreprises, industries ou professions, ce qui aura des incidences sur les coûts de l'adaptation. De plus, un nombre plus élevé de retraites et la variation de la composition par âge de la main-d'œuvre pourraient se traduire par un accroissement des coûts de l'adaptation de la main-d'oeuvre.

Pour chacun de ces domaines, les auteurs examinent les résultats de plusieurs études économiques pertinentes, et ils exposent un certain nombre de questions de recherche.

Introduction

The Canadian population, like those of the other advanced economies, is aging rapidly. One important aspect of population aging is the aging of the Canadian working-age population and workforce.

Most policy-oriented research on population aging to date has concerned fiscal issues, particularly the solvency of public pension plans. The research theme developed in this issues paper (and in the companion paper by Peter Kuhn) is the effects of population aging on the Canadian labour market. The program of research to be developed on this theme is a joint project of Human Resources Development Canada, Industry Canada and the Social Sciences and Humanities Research Council as part of the Innovation Agenda.

The aim of this research program is to reach a better understanding of the effects of the aging on the Canadian labour market. Population aging and workforce aging are not confined to Canada, however, but affect all of the advanced economies. As well as studies that use only Canadian data, research that compares the Canadian labour market and the Canadian workforce to those of other advanced economies (in particular, the U.S.A.) will be welcomed.

1.1. Population Aging and the Labour Market—Background

Canada has experienced a long period of growth in living standards, as measured by rising output per capita. Output per capita is the product of three components: the size of the total population relative to the working-age population (the dependency ratio); the average hours worked by persons in the working-age population; and labour productivity (output per hour worked). Labour productivity depends on the amount of capital per worker in the economy, on the skills held by the workforce and on the ability of the economy to organize productive resources so as to maximize output (total factor productivity).

Through recent decades, demographic factors and labour market factors have favoured rapid growth in living standards. As the baby-boom generation entered the labour market, the ratio of the working-age population to the total population rose and has remained high to the present. The drop in fertility following the baby-boom generation reinforced this tendency.

In the labour market, rising labour force participation rates of women lead to an increase in the average hours worked by persons of working age. Rapid increases in the schooling levels of successive cohorts of labour market entrants, combined with large entering cohorts, meant that the skill level of the labour force rose rapidly, which contributed to increasing labour productivity.

The demographic factors that favoured rapidly rising living standards are now being reversed. The baby-boom cohort is aging—the 1946 birth cohort will reach 60 years of age in 2006 and 65 years of age in 2011. The fertility bust following the baby boom will

mean that the size of labour market entry cohorts will fall relative to the size of the labour force at about the same time the baby boomers enter the group of older workers.[1] Over the period from about 2011 onwards, the share of the working age population in the total population will begin to fall. Within the working-age population, the share of persons aged fifty years and over will rise rapidly.

As a consequence of these demographic shifts, labour force growth is likely to fall to near zero or to zero. The rise in women's labour force participation rates has slowed, so that further growth in female participation is not likely to be a strong source of growth in the workforce. The age composition of the workforce will shift, with a growing share of persons fifty years old and older in the total workforce.

These demographic changes are also likely to have implications for the growth rate of the average skill level of the working-age population. The combination of large entry cohorts and a rapid rise in the schooling level of successive entry cohorts contributed greatly to increasing the skill level of the Canadian working age population. Moreover, there is more skill acquisition while in the workforce among younger than among older workers, so that a shift towards an older workforce may mean that skills growth through this channel slows as well. In sum, demographic changes over the next decades may make it difficult to sustain the rate of growth in the quality of the Canadian labour force.

Finally, important transitions such as population aging impose adjustment costs, even when they are foreseeable and drawn out over time. Furthermore, an adjustment which is drawn out over time for an economy as a whole may be concentrated in time for companies or for industries within the economy. For example, certain occupations, such as health professionals and university professors, have workforces which are far more concentrated in older age groups than is the case for the workforce as a whole.

1.2. Aging and the Work Force—Policy Issues

From the discussion above, it should be clear that demographic changes will make it difficult to sustain past growth rates in Canadian living standards. The ultimate goal that underlies the discussion in this paper is to assist in formulating policies that address the challenges of an aging population. We need to identify the trade-offs involved in maintaining growth in per capita output by prolonging the labour force participation of older workers. We need to identify barriers to labour force participation by older workers. We need to know the costs of adjustment to population and workforce aging and how policy can ease the adjustment process. We need to understand the effects of aging for growth in skills of the Canadian workforce, the consequences for maintaining a highly skilled workforce and an innovative economy, and how policy can influence skills investment among older workers.

Given the limited state of knowledge in Canada on issues related to aging and the labour market, Human Resources Development Canada, Industry Canada and the Social

[1] The size of entering cohorts was sustained by the echo boom (children of the baby boomers), but this effect will end once this group has completed entering the labour market around 2010.

Sciences and Humanities Research Council agreed to include *Labour market adjustments due to population aging* as one of four themes in their joint *Medium-Term Research Project on Skills*. This paper is a step towards developing the policy-research program for this theme. The purpose of this program is to anticipate potential issues and problems and to provide support for designing institutional reforms and new policy initiatives.

Three areas for policy research directly linked to aging and the work force will be taken up in this paper. The first is the determinants of the labour force participation decisions of older workers. The policy questions underlying this research issue are to identify barriers to labour force participation by older workers and to examine the welfare consequences of offsetting the effects of demographic changes by prolonging the employment of older workers.

The second area for policy research is the relation between an aging population and the use of skills in the economy. In particular, this research area concerns: the effects of aging on the level and types of skills supplied by the workforce; and the effects of age differences in skills in the context of an aging population on the demand for labour by employers and on employers' introduction of new technologies and of new forms of workplace organization.

The third area for research concerns the costs of adjusting to population and workforce aging. At the level of the economy, the changes resulting from population aging will occur gradually over a period of twenty or more years. Nonetheless, an increased level of retirements and the changing age composition of the workforce may result in increased costs of workforce adjustments. Furthermore, while changes resulting from workforce aging will occur gradually for the economy as a whole, this may not be true of certain firms, industries or occupations, with implications for adjustment costs.

A simple way of summarizing these three research areas is that the first has to do with quantity, the second with quality, and the third with getting from here to there. The first concerns how policy might seek to maintain the growth rate of living standards by increasing the **quantity** of the labour input (the number of hours worked); the second concerns how policy might seek to maintain the growth rate of living standards by increasing the **quality** of the labour input (the skills level of the workforce); the third concerns how policy might seek to reduce the labour market **adjustment costs** due to an aging workforce. The next three sections of this paper take up each of these areas in turn.

2. Older Workers' Labour Market Attachment: Policy Research Issues

A major challenge associated with population aging is the decline in the size of the working-age population relative to the total population. All else equal, this will lead to a decline in the level of hours worked per capita, but policies which encourage continued employment of older workers can have a considerable offsetting impact.[2] A much better

[2] The size of the working-age population relative to the total population can be affected by immigration policy (increased immigration has a favourable short to medium-term impact) and by policies designed to increase fertility. The latter have unfavourable effects in the short to medium term (increased dependent

understanding of the factors that determine supply and demand for older workers' labour is required in order to design such policies, and the contribution of existing institutional, labour market, or social policies in reducing the adjustment costs due to population aging needs to be addressed.

There are two basic lines of inquiry in this connection. First, what factors influence older workers' labour force supply decisions? Second, what factors influence employers' demand for the services of older workers?

2.1. Older Workers' Labour Supply Decisions

Retirement trends have changed over the past decades, as people spend more time in retirement. According to the Labour Force Survey (LFS), the median age of retirement declined from age 65 years to 61 years between the 1980s and 2000, but has stabilized over the past five years. Another indication that Canadians retire at a younger age is that 43% of retirees retired before age 60 over the period 1997-2000, compared to 29% over the period 1987-1990.

Since the mid-1990s, however, labour force participation rates have increased for both male and female older workers, with a rapid increase from 2001 to 2002. The increase in participation rate appears to be explained by two factors: the sharp declines in real wealth in 2001 and 2002 for both older men and older women; and over the entire period, cohort effects for older women, that is, the significantly higher lifetime participation of females born in the 1950s and after. These cohort effects will continue to increase the participation rates of female older workers over the medium term.

Pyper and Giles (2002) provide evidence that retirees, in particular early retirees, often re-enter employment. Using the *Survey on Income and Labour Dynamics* (SLID), they find that one out of four early retirees returns to the labour market within the first two years after retirement. Full-time job holders are a slight majority of these re-entrants.[3] Furthermore, the younger workers retire, the more likely they are to re-enter labour market after retirement.

The rise in part-time work among older workers shows that retirement, understood as a once-and-for-all cessation of employment, is not the only mechanism by which older workers reduce their hours of work. Marshall (2000) shows a 70% increase in part-time work among older workers in the past twenty years, the highest rate of increase for any age group. Most of these are voluntary part-time workers.

A considerable amount of research on retirement decisions has focused on the labour supply effects of income security programs and changes in these programs. Some research concerns the effects of characteristics of private pension plans on retirement decisions. Other work has examined the role of transitions such as job loss or the onset of

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population, probable decrease in female labour force participation). In the long term, if fertility remains far below replacement levels, the elderly dependency ratio will continue to rise.

[3] 58% of retirees return to work in full-time jobs and 42% of retirees return to work in part-time jobs.

health problems and the influence of demographic characteristics, of job characteristics and of family considerations.

There is evidence that the design of public pension plans can influence labour supply decisions of older workers. Using administrative data for Canada, Baker, Gruber and Milligan (2003) found that the combined effects of a number of programs generate strong disincentives to work after age 60 years. They also found that if there were large financial incentives to additional years of work, older workers tend to delay retirement. Compton (2001), however, finds using SLID data that retirement is chiefly influenced by demographic factors, with little effect of expected CPP/QPP benefits and of current levels of income and wealth. In a simulation study, Gunderson (2001) find that private pension plans with CPP/QPP bridging benefits create large spikes in pension wealth at the age at which these benefits become available, that CPP/QPP has negative pension wealth accrual beyond age 55 years, and especially at age 65 years, and that there are very strong combined public-private pension plan incentives, especially for low-income workers, to retire early because of the means-tested character of OAS/GIS/SPA.

There has been more research on the effects of changes in the public pension plans in the U.S.A. (and elsewhere) than in Canada. Broad conclusions from this research are that small modifications to rules make little difference (Leonosio, 1990; Gustman and Steinmeier, 1991), but that significant changes would have a strong effect on retirement patterns (Gruber and Wise, 1999).

Burtless and Quinn (2001) make the point that income security programs are not the only source of wealth that affects retirement decisions. They find that the long-term increase in wealth in the U.S.A. is the main factor contributing to the decline of the retirement age. They conclude that large changes in the Social Security program would have little impact on the retirement age in the face of a continued increase in individual wealth. Similarly, Tompa (1999), using longitudinal Canadian income tax data found that higher lifetime earnings increase the probability of early CPP/QPP take-up.

There are a certain number of research findings using data from the U.S.A. on the effects of the parameters of private pension plans and early retirement provisions on retirement. Gustman, Mitchell and Steinmeier (1994) provide evidence that workers with generous pension plans tend to retire earlier, but these effects are small. Workers who are offered money to delay their retirement tend to do so. Those workers who are covered by private pension plans tend to leave the labour force at an earlier age (Honig and Reimers, 1989) as do workers who are offered sufficient incentives by early retirement programs (Hogarth, 1988; Lumsdaine, Stock and Wise, 1990). Brown (2000) finds, however, that many workers who accept early retirement plans take "bridge" jobs, rather than withdrawing permanently from the labour force.

The timing of retirement also is affected by other factors than the parameters of income security programs and of private pension plans and the level of individual wealth. Specific events, in particular, job loss and disability may also lead to retirement. Rowe and Nguyen (2002) find that separations for older workers were often due to layoff,

illness disability, or a family-related event, and that probabilities of re-employment were much lower for older than for younger workers. In many cases, labour force exit was triggered by job loss, often followed by an unsuccessful period of job search prior to exit.

Various family-related factors also play a significant role in the retirement decision. For example, Tompa (1999) finds that having a retired spouse increases the probability of early CPP/QPP take-up. Baker (2002) provides further evidence that the retirement decision often needs to be viewed as a joint decision of couples. In his study of the joint retirement behaviour of married couples following the introduction of the spouse's allowance in the 1970's, he shows that eligible couples responded by decreasing their labour force participation rate relative to ineligible couples. Other research in the U.S.A. (Gorey Rice and Brice, 1992, Moen et al., 1994) shows that providing care for family members is relate to reduced labour force participation, especially for women.

Knowledge Gaps:

1. How sensitive are changes in the labour force participation of older workers to changes in the parameters of income security programs? In particular, how sensitive would older workers be likely to react to reductions in disincentives to remaining at work? What are these disincentives in the income security system, in private pension plans and in the tax system?
2. Are the labour force participation decisions of older workers best viewed as individual decisions or as joint family decisions? If as joint family decisions, what are the most important parameters affecting these decisions? With the aging of cohorts of women with higher lifetime rates of labour force participation than in earlier cohorts, how are the labour force participation patterns of older women and of their spouses likely to change?
3. How sensitive is the labour supply of older workers to changes in the real wage? How does the labour force participation of older workers vary with their skill level?
4. Would significant numbers of older workers prefer part-time or part-year work or self-employment or "bridge employment" to complete withdrawal from the labour force, and why? What is the impact of care-giving responsibilities on the labour force of older workers?
5. Are there institutional barriers that tend to keep older workers from working part-time, part-year or as self-employed workers? How flexible are public and private pension plans in accommodating working hours' preferences of older workers? What factors influence the labour force re-entry decisions of retired workers?

Little work has been done so far to evaluate the potential long-run economic welfare gains of encouraging older workers to work longer. What would be the welfare and labour market gains of increasing the average retirement age? Are there policies that would have more impact than others?

2.2. Employer Demand for Older Workers

To understand how the employment of older workers might be enhanced, employers' demand for older workers and their attitudes toward older workers must also be

examined. In this subsection, we discuss differences other than differences in skill that might affect employers' demand for older workers. (The effect of skills differences is discussed in Section 3). Unfortunately, we have not found a large amount of research in this area, although there are scattered findings.

One question of obvious interest is how the overall wage level and the relative wage of older workers will change with population aging. There has been a good deal of work using calculable general equilibrium models on the likely evolution with population aging of overall wage levels and rates of return to capital, but there do not appear to be any definitive answers from this work. Some work has been done on questions of relative wages—skill differentials, gender wage differentials and wage differences between age groups. Disney (1996) reviews studies by Freeman of factor price elasticities with respect to supply for age-gender groups and capital and by Berger for age-gender-education groups and capital. Mitchell and Levine (1988) used a production function approach to investigate how wages would change for eight age-sex categories of workers between 1985 and 2020 in the U.S.A. They found wages would rise for both older (55+) and prime-age (20-54) workers, with no change in the relative wage of the two groups. As Hamermesh (2001) remarks "these studies are based on data that are now quite obsolete (that reflect the skill levels of the population in the 1970s); and little research has been done on this issue since the 1980s.

Older workers' productivity might differ from that of younger workers because of health problems or loss of capacities due to aging, but there is little direct evidence that this is the case. The OECD (1998) cites the "gerontological/psychological" literature as finding "no significant overall difference between the job performance of older and younger workers". (p. 136) Crompton (1996) finds lower absenteeism and little evidence of lower cognitive skills among older workers. Older workers are, however, more likely to suffer poor health and disability. (OECD, 1998, p. 136) To the extent that this imposes costs on employers, it may affect their willingness to hire older workers.

There has also been research on differences in the percentage of older workers hired in various types of jobs and the percentage of older workers in the workforce for these jobs. Hutchens (1988) and Hirsch, MacPherson and Hardy (2000) find significant differences of this type which vary across industry-occupation cells. There does not appear to be any generally accepted model as to why employers' propensity to hire older workers should differ from their propensity to employ older workers. Hirsch et al. explore various possible explanations. Of these, shorter periods over which to recoup various types of employer investments (in job match, in training) seems an obvious possibility. For deferred compensation schemes to play a role, newly hired older workers would have to be treated differently than younger workers newly hired in the same position. Other possibilities include labour market segmentation and unobserved differences between employed and unemployed older workers.

One relevant strand of labour market research is on long-term contracts between employers and employees. For example, Lazear's (1979) model has workers paid below their marginal productivity in their early years with a firm, compensated by above-

marginal-productivity earnings in their later years. This elicits effort by young workers, so as to be retained with the firm and to profit later from above-marginal-product earnings. Mandatory retirement provisions exist so that firms will not have to pay older employees above their marginal productivity indefinitely.[4] It is obviously of interest to know how population aging will affect the prevalence of arrangements of this type and how it will affect older and younger workers who believe they have an unwritten contract along these lines.

One area in which there appears to be very little research is on the determinants of employers' willingness to provide transitional employment towards retirement or to continue some kind of market relationship with retired employees of the firm. It may be that part-time work or part-year work with the former employer is the preferred form of labour supply for many older workers. This might be in a different kind of employment relationship ("casual employee") or as a self-employed contractor. It remains to determine when and under what conditions employers find such arrangements to their advantage.

Knowledge Gaps:

1. Why are there differences between hires and employment of older workers (assuming there are such differences in Canada)? How do differences of this type vary by occupation and industry, and what are the implications for the hiring prospects of older workers in the context of an aging workforce?
2. Under what circumstances are firms likely to wish to provide older workers opportunities for part-time or part-year employment as a transition to retirement? In what type of firms and for which employees? How workplaces' practices and flexibility can help improve labour market attachment of older workers?
3. Are there obstacles to re-employment and labour force participation of older workers such as ageism, reduced job opportunities or wage expectations, or firms not accommodating older worker's disability or other health problems?
4. What are the implications of various types of institutional arrangements such as collective bargaining and (non-written) deferred-compensation contracts for employers' demand for older workers? What is the likely impact of population aging on these types of arrangements and the implications for demand for older workers?
5. Are there differences between the abilities of older and younger workers that affect their productivity and, if so, how do these differences influence the demand for older and younger workers?

3. Workforce Aging and Skills

This section explores the relation between population aging and the availability and use of skills in the Canadian economy. We need a better understanding of these issues in order to formulate policies aimed at maintaining growth in labour force skills and supporting innovation. Policies in this area would aim at removing barriers to skill

[4] Even when mandatory retirement ages are prohibited by law, pension plans can be structured so as to provide very strong incentives to leave at a given age, for example, by capping retirement benefits.

investment, at maintaining and updating the skills of older workers and at encouraging skills investment.

The rising level of skills in the Canadian economy has been an important source of productivity growth. A recent study (Baldwin and Harchaoui, 2002) finds that between 1981 and 2000, the rising quality of the Canadian work force accounted for about over a third of the total growth in business sector labour productivity (Our computation from Table 1.5). Part of the gains in total factor productivity over this period may also have required a highly skilled labour force, as several authors have argued that this is a prerequisite for the introduction of improved forms of work organization and for innovation.[5]

3.1. Workforce Aging and Growth in the Level of Skills

As discussed in the Introduction, there are several reasons to think that workforce aging may lead to slower gains in the quality of the workforce than over recent decades and to shifts in the types of skills held by the workforce. Economists generally distinguish between two broad sources of job skills: skills acquired through schooling and skills acquired through training while in the workforce. The usual assumptions concerning these two types of training are that schooling precedes entry to the workforce and that training while in the workforce is more intensive earlier than later in the work life.

While these assumptions do not hold for every individual, they have considerable support as broad generalizations. For example, in Canada in 1998, persons less than 32 years old were more than 80 percent of all university graduates. As concerns the relation between training and age, the 1998 Adult Education and Training Survey shows a decrease in the incidence of job-related training from 30.6% of the 25-34 years age group to 23.7% of the 45-54 years age group to 8.4% of the 55-64 years age group. The mean hours of training, for those who trained, drop off much more rapidly with age—from 272 hours per year for the 25-34 years age group to 106 hours per year for the 45-54 years old age group. (Statistics Canada, 2001, Annex C, Table 1.7)

As the workforce ages there are thus at least two reasons to think that the pace of skills growth may slow. First, entry cohorts will be smaller relative to the total size of the workforce, resulting in a decreased impact of higher educational levels in entry cohorts on the overall educational level of the workforce. Unless schooling levels of youth increase strongly in future decades, the growth in the educational level of the workforce will slow.[6]

Second, the concentration of the workforce in older age groups means that the average training hours per year of persons in the workforce will be lower, unless there are changes in the training intensity at different ages. Such changes might well occur. If

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[5] Guillemette (2003) predicts slower growth in multi-factor productivity as a result of aging.

[6] There is an offsetting effect from higher exits by less educated older workers, but the net effect is that without further increases in the educational level of youth, growth in the educational level of the workforce will continue, but at a slower pace.

wages rise in response to aging and workers remain in the workforce longer, their incentives to invest in skills at older ages are likely to rise. Among the major objectives of this project is to better understand possible endogenous adjustments and the mechanisms underlying these adjustments, in particular, the relation between training and age. A better understanding of these issues would be very useful in the development of policies to encourage training of older workers.

Knowledge Gaps:

1. What is the present composition of the skills stock of the Canadian workforce between skills acquired through schooling and skills acquired through work experience? How has this evolved over recent decades?[7] How is it likely to evolve with population aging?
2. With endogenous labour market adjustments to population aging, what are the likely effects on levels of skill investment through schooling, levels of skill investment during the work life, and the proportions of skills acquired through schooling and through training over the life cycle?

3.2. Workforce Aging and Changes in the Composition of Skills

The discussion to this point has concerned the impact of workforce aging on the level of skills without regard to the type of skills held. From the earlier discussion it is clear that older workers will have acquired a greater proportion of their skills from training while in the workforce than is the case for younger workers. If there are qualitative differences between skills acquired through schooling and skills acquired through training while in the workforce, older workers will have relatively more "training-type" skills relative to their levels of "schooling-type" skills than younger workers. Hamermesh (2001) notes that skills are likely to be an important factor in determining the substitutability of workers in various age groups.

There is evidence of qualitative differences between the skills of younger and older workers. Cohort studies show, for example, that shifts in the return to schooling and to work experience do not affect all birth cohorts in the work force uniformly. For example, Beaudry and Green (2000) find that age-earnings profiles of Canadian university-educated men shifted downwards from 1964 to 1990, but the slope of the profiles at various ages was unchanged. This is consistent with a fall in the rental rate of skills men acquire through university education, but a constant rental rate for the skills university-educated men acquire during their work experience.

More directly, Card and Lemieux (2002) find elasticities of substitution between older and younger workers of around 2.5, so that these groups are not perfect substitutes in production. Disney (1996, p.159) notes a non-infinite elasticity of substitution between older and younger workers as a pre-condition if changes in the age composition of the workforce are to have a significant impact on wage differences between age groups. If

[7] Laroche and Mérette (2000) do not report their findings in a form that allows us to answer these questions, unlike Wasmer (2001) for France and the U.S.A.

less-than-perfect substitution between different age groups results from differences in skill, these differences must be in the types of skills held by each age group, as well as in their level.[8]

Wasmer (2001) documents the shift in recent decades in the total skills stock in France and in the U.S.A. from having a high proportion of skills acquired during work experience to having a high proportion acquired during schooling. Using a variety of estimation techniques, he finds elasticities of substitution for the U.S.A. between these two skill types of 1/5 to 1/3, so that they are complements.

Knowledge Gaps:

1. We know very little about the composition of the stock of skills in the workforce, especially for skills acquired through training. Employers distinguish between technical skills and soft skills, which include management skills, communications skills and teamworking skills. They claim that there is a lack of soft skills. (See Expert Panel on Skills, 2000) Does the make-up of individuals' skill sets as between technical skills and soft skills change over the work life? Are soft skills best acquired through learning while in the workforce?
2. Economists distinguish between various kinds of human capital: general and firm-specific (Becker, 1964), occupation-specific (Shaw, 1984), industry-specific (Neal, 1995). To what extent are each of these types acquired through schooling and to what extent through training while in the workforce? How has the division of the human capital stock between firm-specific, occupation-specific, industry-specific and non-specific human capital evolved, how is it likely to evolve, and what are the implications in combination with population aging.

3.3. Technological Change, Aging and Skills

There are several strands to the research literature relating technological change, organizational change, skills and aging. We take up the study of vintage effects in human capital here; issues concerning training are discussed below. Vintage effects are losses of economic value of human capital that results from technological change that makes this human capital partially or completely obsolete.

Two points can be raised in this respect. First, since older workers will have human capital of an older average vintage, an older workforce will have a higher rate of loss to obsolescence than a younger workforce (all else equal). Thus workforce aging will accentuate vintage effects. Second, Neuman and Weiss (1995) (among others) provide evidence that vintage effects are stronger in 'high-tech" than in 'low-tech' industries. If

[8] Homogeneous skills (of which different groups of workers can have more or less) by definition implies perfect substitutability between the skills of various groups. Thus if skills are homogeneous, skills differences cannot be the reason for less than perfectly elastic substitution between older and younger workers, even if these groups differ in the quantity of skills they hold. Inelasticitiy of substitution then would have to be due to other types of differences between older and younger workers.

so, employers in 'high-tech' industries should prefer more recent graduates at the same wage rate, because their human capital is more productive in the industry.

This might mean that an aging workforce would impede the introduction of new technologies and the shift of production to 'high-tech' industries. This would occur if older workers with older vintages of human capital were less able to work with the new technologies. (The related issue of training of older workers in new technologies is considered below).

Weinberg (2002) considers how new technologies affect the returns to experience and how experience affects the adoption of new technologies. His model allows for both vintage effects and complementarities between existing skills and new technologies. He finds that among "college-graduate" men in the Current Population Survey (U.S.A.), young workers have adopted computers most intensively and the returns to experience have not changed. Among high-school-graduate men, however, workers with 30 to 40 years of experience have adopted computers most intensively and the returns to experience have increased. He interprets his findings for "college-educated" men as the operation of a traditional vintage model, but interprets his findings for high-school-graduate men as evidence for complementarities between existing skills and new technology.

To our knowledge, there are no studies using Canadian data of vintage effects or of complementarity between existing skills and new technologies.

Knowledge Gaps:

Are there important vintage effects for human capital in the Canadian economy? Complementarities between existing skills and new technologies? What is the industrial and occupational structure of vintage effects and complementarities? If there are important vintage effects, will Canada's industrial and occupational structure accentuate these effects, relative to other advanced economies? Is an aging workforce with an "older vintage" of human capital likely to be a significant obstacle to technological change and to shifts in employment towards high-tech industries?

3.4. Training, Technological Change, Organizational Change and Workforce Aging[9]

For the most part, workers acquire skills through training once they have entered the workforce. Consequently, understanding the determinants of training, in particular for older workers, is key to an understanding of how to maintain the skills growth as the workforce ages.

We discussed above the observed tendency for training to decrease with age. The standard economic explanation for this decrease is that with a shorter remaining work

[9] Training is another of the themes of the joint research project on skills. Some of the points discussed in this section are developed more fully in one of the issues papers for the roundtable on training, Linand Tremblay (2003).

life, there is less time remaining to earn returns on a given investment in skill. This explanation is usually presented in a model in which the individual pays for the training received through foregone earnings.

Recent economic research on training suggests that employers may bear some or all of the costs of training in general skills. (This research is summarized in Lin and Tremblay, 2003). The argument as to the relation between the time horizon for returns and the level of skill investment would still hold in this context. The relevant time horizon becomes the time until the employee leaves the firm, whether by retirement or otherwise, not the time until retirement or death (as for the individual).

The OECD (1998) compares five-year retention rates of workers with firms by workers' age and tenure for a number of countries. The authors state that "retention rates remain relatively high and comparable with those of prime-age workers through approximately age 50-54 years. Beyond the age of 55, the probability of an older worker remaining a further five years with the same employer declines substantially". (p. 138) Thus up until age 50 years, employers have little time horizon disincentive to train older workers. If changes related to population aging lead to a longer work life, these disincentives would become effective at an older age than is presently the case.

In addition to age, educational level has an important effect on whether an employee receives training. Estimates from the 1998 Adult Education and Training Survey show that with age, labour force status and gender taken into account, persons with a university degree are about three times as likely to receive training as those with a high school diploma (Statistics Canada, 2001, Annex C, Table 1.6a).

Bartel and Lichtenberg (1987) provide a possible explanation for the concentration of training among more educated workers. They develop a model in which training rises with schooling (once age is taken into account) because more educated workers "have a comparative advantage with respect to learning and implementing new technologies". The authors report estimation results that support this model. Note that this model implies that schooling and training are complements in the supply of skills, while Wasmer (2001) finds skills resulting from schooling and from training to be complements in production.

Bartel and Lichtenberg's model can be viewed as a model of "trainability", that is, of how much it costs to provide workers of given characteristics the same increment of skill through training. Welch and Ureta (2002) argue that much of the economic value of education lies in the ability schooling develops to organize and to process new information.Complementarities between schooling and "trainability" lead to higher levels of training for more educated workers.

A more direct approach to "trainability" is to ask whether older workers have more difficulty in learning certain skills than younger workers. Borghans and ter Weel (2002) ask whether older workers have more trouble learning to use a computer. They find evidence from the Skills Survey of the Employed British Workforce that the 20-29 years

age group has less trouble learning computer skills than do other age groups, so that there may be a relation between age and the investment required to learn certain skills.

Another body of research on training directly concerns the relation between technological change, training decisions and retirement decisions.Bartel and Sicherman (1993) develop a model of individual training decisions and technological change. They cite empirical evidence of higher levels of training in industries with more rapid technological change and formulate a model in which this may result in higher levels of training, and consequently in later retirement ages, in these industries.[10] They find support for both of these hypotheses in their empirical results. On the other hand, an unforeseen acceleration of the rate of technological change will lead to earlier retirement. Friedberg (2003) further explores the relation between technological change, training decisions and retirement decisions for older workers. Her conclusions include that older workers have lower levels of computer use because their impending retirement makes the return to the required investment in training lower. Friedberg's empirical analysis also suggests that computer users choose to delay retirement. The implication is that training can prolong labour force participation by increasing the individual's wage.

Bartel and Sicherman's and Friedberg's studies concern the training investment decisions of individuals and their relation to technical change. Research on innovative firms (Baldwin and Peters, 2001) indicates that training decisions may be part of the firm's decision to introduce innovative technologies. Employers may bear the cost of training as part of the cost of change when new technologies are introduced. Thus if the cost of training increases with an older workforce, the pace of technical change may be slowed.

One tendency in the recent research literature on productivity organization (Bresnahan, Brynjolffson and Hitt, 2002) emphasizes the role of the adoption of reorganized work structures in increasing productivity. The reorganization of the work structure is often stated to be dependent on a more-educated workforce and the increased availability of information technology.

Brynjolffson and Hitt (2000) discuss examples of firms' adaptation of these sets of practices. In one example (MacroMed), a firm's "management concluded that the best approach was to introduce the new equipment in a "greenfield" site with a handpicked set of young employees who were relatively unencumbered by knowledge of the old practices". (p.27) This seems to imply that older workers have more difficulty in adapting to a transformed workplace. (The authors do not draw this implication). If so, an older workforce would slow the adoption of these practices and the resulting productivity gains would be decreased.

Knowledge Gaps:

1. What is the interaction between education, training and age? Is there a deterioration of "trainability" with age? If so, does it apply to all levels of education? Are older

[10] This requires that the effect of increased training in prolonging the optimal length of the work life more than offset the higher rate of skills depreciation in industries with more rapid technological change.

workers who receive training more likely to remain in the work force? What are the principal factors influencing older workers' decisions to train? Employers' decisions to train older workers?

2. Is an older workforce likely to affect the rate of technological change? The adoption of new workplace practices? What kind of training strategies, work practices, and strategies for technological change might employers develop to accommodate an aging workforce.

4. Workforce Aging, Skills and Adjustment Costs

Population aging and workforce aging will lead to changes in the Canadian economy and in other advanced economies. We know that population and workforce aging will require significant adjustments in the Canadian economy and in the Canadian labour market. To formulate policy to facilitate adjustment, we need a more precise idea of what these adjustments will be, where and when they will occur, what the costs of these adjustments will be, and who will bear these costs.

Kuhn (2003) notes in the other issues paper for this round table that these changes will operate through two channels: a population aging channel which operates through the composition of final demand, and a workforce aging channel. Labour market adjustment to aging will occur through changes in flows into and out of the labour market and in flows within the labour market. Many of the adjustment cost issues raised by these flows are discussed in the Kuhn paper; a number are taken up here at some risk of overlap.

One result of workforce aging will be a greatly increased level of retirements. This retirement wave is likely to begin in approximately five years as the first birth cohorts of the baby boom reach age 60 years, grow over the next five years, then continue at high levels for twenty years. For the economy as a whole, this will be a gradual change. Certain firms and industries, however, may have a high concentration of older workers in a narrow age range, so that retirements will be highly concentrated in time. The age structure by industry and occupation shows that this is the case for a certain number of industries and occupations. (Betcherman and Leckie, 1995; MacKenzie and Dryburgh, 2003)

Retirements impose a replacement cost on the firm (unless the position is suppressed when the employee retires). Moreover, in firms with a hierarchical organization, retirements may trigger a chain of job moves with concomitant costs. Very little appears to be known about the structure of costs resulting from retirements. In particular, little is known about the relation between the rate of retirement (as a proportion of the firm's workforce) and the average cost of a retirement. It seems likely that average costs would rise as the retirement rate rises, so that a concentration of retirements could impose very heavy adjustment costs on firms.

The Canadian economy supports high levels of permanent employment separations (the annual gross flow is equal to about 20% of employment according to Statistics Canada (1998) which suggests that replacement costs may be fairly low. This might be

misleading as concerns retirements, however. The annual flow of separations is heavily concentrated among younger workers, and so is likely to cause only small losses in the value of job match and of investment in firm-specific skills. (Tables 4 and 6) Separations are also concentrated in industries with a high seasonal component of employment; again, this may mean that the cost of the average separation is far lower than the cost of the average retirement. (Table 8)

Another adjustment cost for firms and the economy is the costs that arise as some firms and industries expand and others contract, requiring a reallocation of workers among firms. The OECD (1998) cites estimates that show that even when other (observable) differences are taken into account, firms are significantly less likely to hire older than younger workers. (pp. 144-145) This presumably reflects higher costs associated with hiring older workers (unless it is the result of age discrimination).

As the workforce ages, maintaining the present levels of labour mobility would require a large rise in labour mobility levels among young workers or, more plausibly, an increase in labour mobility levels for workers of all ages. A shift towards a greater component of older workers in the inter-firm and inter-industry flows of workers might imply higher adjustment costs. This could occur both because older workers cost firms more than younger workers (see the preceding paragraph) and because these workers have high fixed costs to mobility. (Loss of firm or industry-specific human capital, loss of home equity with geographic mobility, and so on). Older workers will also have a shorter remaining worklife over which to recoup their losses to involuntary mobility and their investment in voluntary mobility. Thus an aging workforce might imply costlier labour market adjustments and a less responsive labour market due to higher adjustment costs.

Knowledge Gaps:

As concerns retirements, we know very little about the age structure of employment within Canadian firms, nor the age structure of employment by occupational group within Canadian firms, nor how uniform the firm age structure of employment is within industries. We know very little about the costs retirement imposes on a firm, nor about how these costs vary as the level of retirements rises. We know little about the relation between the age of new hires and the recruitment costs for firms, in particular, how recruitment costs vary with age and with the occupational level of the new hire. We do not know how all of these factors vary with industry, how they differ between Canada and other advanced economies (in particular, the United States) and what differences with other countries are due to differences in industrial structure.

5. Conclusion

This paper discussed a broad range of knowledge gaps in our understanding of how workforce aging will affect the labour market. The companion issues paper by Peter Kuhn identifies a series of knowledge gaps with respect to labour market flows resulting from population aging. The discussion in the present paper is organised in three sections, the first on issues related to maintaining or increasing the employment levels of older

workers, the second on issues related to the impact of workforce aging on the level and composition of skills in the Canadian workforce, and the third on adjustment costs that may result from workforce aging. Our goal is to support policy-making by adding to our knowledge in the following three areas: 1) barriers to labour force participation of older workers and welfare trade-offs that would result if the decrease in the size of the working age population relative to the total population is offset by increasing employment of older workers, 2) the effects of workforce aging on the level and composition of skills in the Canadian workforce and the implications for maintaining living standards and an innovative economy 3) the adjustment costs arising from workforce aging.

To formulate policy, we need a better understanding of how older workers make their labour force participation decisions and their skill investment decisions. We need a better understanding of employers' hiring, employment and skill investment decisions concerning older workers. We need a better understanding of what endogenous adjustments will result from population aging, so that policy initiatives can reinforce desirable adjustments and help offset those with an unfavourable impact. We need a better understanding of how older workers' decisions and employer decisions concerning older workers differ between Canada and other countries, in particular, the U.S.A., and of the sources of these differences. We need a better understanding of how the effects of workforce aging in Canada will compare to those in other countries, again with a particular emphasis on the U.S.A.

There are thus a large number of potential areas for research on these subjects. The first role of this workshop will be to identify those areas in which progress in our understanding is feasible within the time frame of this program and those in which it is not feasible (due to lack of suitable data or for other reasons). The workshop's next role is to establish priorities among feasible research areas as to which can yield the most significant contribution to formulating policy. The final role of the workshop is to help reach a better formulation of the research issues.

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